TABLE 7.—*Monthly and annual sums of the 17-year mean of the sun and sky radiation upon a horizontal surface at Madison, Wis., from April, 1911, to March, 1928, inclusive, in gram calories per square centimeter*

Year	January	February	March	April	May	June	July	August	September	October	November	December	Year
1911				11,742	15,843	16,153	17,202	14,072	10,598	6,533	4,554	4,217	100,644
1912	6,297	6,953	12,006	12,663	11,948	16,891	15,623	13,380	10,001	7,932	5,137	4,024	122,855
1913	4,651	7,584	10,008	13,380	13,906	17,704	17,413	13,028	9,829	7,380	4,218	3,717	122,818
1914	3,196	7,422	9,854	12,213	16,238	15,203	17,417	14,128	11,060	7,070	5,656	4,320	123,767
1915	4,988	5,062	11,883	13,069	12,494	14,605	13,273	12,884	9,429	7,934	4,947	3,519	114,087
1916	4,117	7,292	10,272	12,727	15,024	15,673	17,872	14,516	10,486	7,793	4,831	4,469	125,072
1917	6,106	8,147	10,031	11,730	16,002	13,630	16,736	14,239	10,562	6,400	4,319	4,190	122,092
1918	5,982	7,145	11,446	11,883	14,194	15,681	16,187	13,711	10,246	7,026	4,395	2,697	120,593
1919	4,878	5,926	9,739	10,042	14,752	14,779	16,014	15,297	9,970	6,298	4,820	4,342	116,857
1920	5,357	6,616	10,175	11,432	16,410	16,007	16,219	13,783	10,940	7,701	3,712	3,266	121,618
1921	4,130	5,394	8,219	11,649	14,794	15,671	16,842	13,837	10,889	7,317	3,864	3,680	116,286
1922	5,710	6,937	8,677	11,437	14,380	15,664	15,112	14,032	11,039	8,177	3,481	3,788	118,434
1923	4,025	6,502	11,122	12,712	16,529	14,986	15,655	12,928	9,069	7,218	4,149	3,302	118,197
1924	5,166	6,015	8,465	11,085	13,810	12,952	15,579	13,530	9,591	8,417	4,128	3,868	112,606
1925	4,869	5,161	9,916	12,167	16,795	16,920	15,596	14,050	9,810	5,823	4,478	3,649	119,234
1926	4,638	5,185	9,530	14,732	15,497	16,722	14,760	13,120	7,940	6,262	3,708	3,392	115,486
1927	4,532	6,286	8,816	10,515	11,592	16,362	16,489	14,601	9,131	7,444	3,282	3,502	112,552
1928	4,749	6,743	10,635										
Means	4,906	6,492	10,047	12,053	14,718	15,623	16,117	13,832	10,035	7,219	4,334	3,761	119,137

DISCUSSION

Note on Figure 2 of Piippo's paper.—The author intimates in his text that the rather steady decrease in the annual totals of radiation, as indicated by the broken line in Figure 2, can be accounted for in part only by increased smokiness of the atmosphere of Madison due to an increase in the consumption of bituminous coal as a fuel in recent years. Also, while there is, in general, accord between average annual cloudiness and the total annual radiation from year to year, there is no evidence of an increase in cloudiness in recent years as compared with the earlier years covered by the pyrheliometric record.

It remains to ascertain if the recording pyrheliometer may not have deteriorated during the 17 years it has been in use. There are three ways in which we might expect deterioration, as follows:—

(1) The blackened grids might become less black or the platinum wires of the bright grid might tarnish. Visual observations do not indicate that this is the case.

(2) The glass dome covering the grids might become less transparent. Visual observations do not show that this is the case. However, such observations are quite inconclusive.

(3) A sliding contact on a bridge wire maintains a balance in the two arms of the bridge which is a part of the register, and if this wire becomes worn its resistance increases and less movement is necessary to balance the heating of the black grids by radiation of a given intensity. In consequence there is lessened movement of the pen over the intensity scale of the record sheet. Since the wire has been kept coated with oil there can have been little wear on the wire.

Nevertheless, there is opportunity for deterioration of the apparatus in the manner indicated above, and the only practicable way to detect it is to recalibrate the pyrheliometer occasionally.

In Table 8 are given summaries of comparisons between the measurements of the intensity of the vertical component of direct sunshine by the Callendar and the Marvin pyrheliometers.

The ratios shown indicate that the Callendar register now records 3 per cent lower than it did in the years 1913–1915, and this will account for about half the decrease in annual radiation receipt during the above period. The remaining half I am inclined to attribute to increased smokiness, which is not apparent in the atmospheric transmission coefficients of Table 2 for the reason that observations with the Marvin pyrheliometer are not made on days when the atmosphere contains much smoke.

TABLE 8.—*Values (f) of a scale division of the Callendar pyrheliometer in gram calories per minute per square centimeter, as determined by comparisons between the Callendar and Marvin pyrheliometers*

Years	Solar altitude	Number of observations	f	Solar altitude	Number of observations	f	Solar altitude	Number of observations	f
1913-1915	58.3	15	0.0346	43.0	16	0.0342	29.8	14	0.0354
1917	60.6	10	.0353	43.6	7	.0354	30.2	5	.0377
1927				41.2	19	.0358	30.9	14	.0367
Ratio $\frac{1917}{1913-1915}$			1.020			1.035			1.065
Ratio $\frac{1927}{1913-1915}$						1.047			1.037
1913-1915	20.1	3	.0380	15.9	3	.0423	14.3	3	.0502
1917	21.8	4	.0371						
1927	22.5	8	.0382	15.6	2	.0417	12.6	1	.0489
Ratio $\frac{1917}{1913-1915}$			.0976						
Ratio $\frac{1927}{1913-1915}$			1.005			.0986			.0974

Weighted mean ratio (all Solar altitudes) $\frac{1917}{1913-1915}$, 1.024 $\frac{1927}{1913-1915}$, 1.032.

The Marvin pyrheliometer at Madison was compared with Smithsonian pyrheliometer No. 1 on September 29, 1928, and the mean of three series, each covering a period of about 30 minutes, gave for the ratio $\frac{\text{Marvin}}{\text{Smithsonian}}$ the value 1.002. Smithsonian No. 1 is frequently compared with substandards at the Smithsonian Institution. It was last compared on February 28, 1928, and was found to be in accord with them within the error of observation. This has been the result of all comparisons made since May 3, 1920; and since July 12, 1910, the change in the ratio between Smithsonian substandards and Smithsonian No. 1 has been only 0.7 ± 4.34 per cent, No. 1 appearing to read that amount lower at the present time.—*H. H Kimball.*